

in their relative size and position. The *labium*, however, though similar in form, is distinctly broader than the fore extremity of the sternum (fig. 2, *b*); while in *L. desultor* it is represented in figure 5 of Schiödte's plate as narrower.

A single example of the adult female in the British Museum.  
*Hab.* Penang.

Naturalists and collectors in Penang should endeavour to find other examples of this genus, of which all our knowledge at present is based upon the two specimens mentioned above. Besides the interest attaching to the presence or absence of spinners, they are the only spiders, as yet discovered, whose abdomen is protected by articulated corneous transverse plates, similar to those found in the orders Scorpionidea and Thelyphonidea.

XXXII.—*On the Geographical Distribution of Fishes.*

By THEODORE GILL, M.D., Ph.D.\*

ABOUT 9000 species of living teleosteous fishes are now known, variously distributed and found in greater or less numbers in almost all the waters of the globe, fresh and salt; the greatest numbers of species, however, are found in the tropical waters, and especially in the seas of the Indo-Moluccan archipelago. The distribution of the types, especially of the marine species, to a considerable degree coincides with thermometrical conditions. In the polar and northern temperate regions, for example, are found representatives of the families of Gadoids or codfishes, Lycodoids, Stichæoids, Liparidoids, Cottoids or sculpins, and others less known. In the tropical regions many forms are distributed throughout the entire zone (and therefore designated as tropicopolitan), this being especially the case with many genera of Labroids, Scaroids or parrot-fishes, Pomacentroids, Gerreoids, Serranoids or groupers, Sparoids, Carangoids, and others—numerous species of these families being found in torrid waters, while very few extend far northward or southward. In the antarctic regions, again, we have another combination of forms: typical codfishes and the other types characteristic of high northern latitudes are wanting, but are severally replaced by peculiar groups, which seem to fill an analogous place in the economy of nature, having a superficial resemblance in general aspect, although they are not at all (comparatively speaking) related in structure.

\* Reprinted, with additions by the Author, from advance sheets of 'Johnson's New Universal Cyclopædia.'

The Gadoids, for example, are replaced by Notothenioids, the Lycodoids by peculiar genera, the Cottoids by Harpagiferoids, &c. In the contrast between these antarctic and the arctic forms we have evidence of the absence of any paramount causal relation between temperature and structure; and, in addition to the "tropicopolitan" types, each great tropical region has a number of characteristic and peculiar types.

But the distribution of the inhabitants of the great open seas and of those of the inland waters are determined by different conditions, as might *à priori* be supposed. While, for example, the inhabitants of the opposite sides of converging continents are to a great extent similar, the freshwater species of those continents are mostly quite dissimilar, and become more and more so as we progress southward.

There are numerous families of fishes which are represented in the fresh waters—some exclusively so, others with marine species. The geographical limitations and relations in space of these families may be exhibited under combinations in several categories\*, viz. :—

1. Peculiar to North America—Percidæ (*Etheostominae*), Centrarchidæ, Aphredoderidæ, Amblyopsidæ, Percopsidæ, Hyodontidæ, Amiidæ, and Lepidosteidæ.

2. Peculiar to Tropical Asia—Platypteridæ, Helostomidæ, Osphromenidæ, Nandidæ, Luciocephalidæ, Ophiocephalidæ, Notopteridæ, Salangidæ, Homalopteridæ, and Sisoridæ.

3. Peculiar to Africa—Kneriidæ, Mormyridæ, Gymnarchidæ, and Polypteridæ.

4. Peculiar to tropical America—Centropomidæ, Polycentridæ, Sternopygidæ, Electrophoridæ, Hypophthalmidæ, Trichomycteridæ, Callichthyidæ, Argiidæ, Loricariidæ, and Aspredinidæ.

5. Peculiar to Australia—Gadopsidæ, Ceratodontidæ.

6. Peculiar and common to the cistropical hemisphere (that is, Northern America, Europe, and Northern Asia)—Gadidæ (*Lotinae*), Cottidæ (*Uranidæ*), Percidæ (*Percinæ*), Gasterosteidæ (*Gasterosteinae*), Esocidæ, Umbridæ, Catostomidæ (America and Eastern Asia), Salmonidæ, Acipenseridæ, and Polyodontidæ (America and Eastern Asia).

7. Peculiar and common to Europe and Asia—Cobitidæ.

\* As might naturally be supposed, the forms assigned to the categories enumerated are not always rigidly limited to the specific regions when contiguous regions are contiguous: thus the Cichlidæ send representatives into the regions of Asia near Egypt, and the Lepidosteidæ have a representative as far southward as Panama. In the latter case, indeed, the question might even arise whether the Lepidosteidæ might not rather be immigrants into North America than the reverse; but a recourse to palæontology solves the question.

8. Peculiar and common to South America and Australia—Percophididæ, Haplochitonidæ, Galaxiidæ, and Osteoglossidæ.

9. Peculiar and common to tropical and subtropical America and Africa—Cichlidæ, Characinidæ, and Lepidosirenidæ.

In addition to these, the family Cyprinidæ is represented in the entire cistropical or "arectogean" hemisphere as well as in tropical Africa and Asia; and there are several monotypic families limited to very small regions, such as the Comephoridæ, the single species of which is only known from Lake Baikal. There are, further, a number of families (in addition to several already mentioned) which are chiefly represented by marine species, but which have also a greater or less number of representatives in fresh water in different regions of the earth; such are the Brotulidæ, Blenniidæ, Gobiidæ, Sciaenidæ, Atherinidæ, Mugilidæ, Cyprinodontidæ, Microstomidæ, Clupeidæ, Dorosomidæ, &c.

Others, again, were represented in former epochs in parts of the world where they are not now found; and especially to be noted among these are two families at present characteristic in their distribution: the first of these is the Cobitidæ, which in the early Tertiary were inhabitants of Western America, and which thus increased the similarity of the fauna of our (cistropical) continent to that of Northern Asia; the second is the Ceratodontidæ, a family whose representatives have long been known from fossil teeth found in Palæozoic and Mesozoic deposits (and which were referred by Prof. Agassiz to the sharks), and had been supposed to have expired towards the end of the Triassic epoch; yet recently (since 1870) two species, closely allied to those found in the Triassic beds of Europe, have been discovered *living* in Australia; and thus another ancient type has been preserved in that continent to illustrate the past life of our own hemisphere.

If we now seek to apply the knowledge thus gained to the appreciation of the origin of the different fish-faunas of the globe, we are forced to the following conclusions.

Inasmuch as the cistropical hemisphere shares in common the same families, and to a considerable extent the same genera (and even some species), it is presumable that the different regions of that hemisphere have derived their inhabitants from a common primitive source, although North America has quite a large proportion of forms peculiar to it. The relation of these peculiar forms, however, are in all cases rather with some found in the northern hemisphere (freshwater or marine) than with any found elsewhere; but, at the same time, towards the south-western limits of the United States occur representatives of families which are characteristic of tropical

America. Further, it is to be remarked that several of those forms whose living representatives are most characteristic and peculiar to North America, *e. g.* Amiidae and Lepidosteidae, were in previous geological epochs represented by species in Europe; while the Cobitidae, now unrepresented by living American species, had, as already remarked, examples in more ancient times in that continent.

Tropical Asia nourishes a great number of peculiar forms; but the relations of those are intimate either with cistropical ones or with marine types.

Africa has Cyprinoids and Anabantids in common with tropical Asia, and Cyprinoids in common with the cistropical hemisphere; but it also supports several very peculiar families for whose relations we have to seek in other continents.

In tropical America are to be found the nearest relations of some of these African types, and several almost or quite limited to those two continents. On the other hand, in South America are found several families having no analogues in the parts of the world yet mentioned, but for which we have to turn our eyes to Australia; and there we have representatives of not only the same families, but even, it has been contended, one of the same species. Under these circumstances we are almost compelled to believe that the fish-fauna of South America was derived, at a distant epoch, to some extent from a common source with that of Africa and that of Australasia. We have, however, at first sight, contrary indications; but they are not irreconcilable: the most conspicuous and, as it were, obtrusive types of South-American fishes are analogues of African forms, members of the families Cichlidae and Characinidae; but the species belong to widely different genera. On the other hand, although the types common to South America and Australia are not conspicuous in numbers or economical importance, they are much more nearly related to corresponding Australian species than the former, and, in common with other facts, tend to verify Huxley's views respecting an "Austro-Columbian" fauna.

In fine, dividing the earth into regions distinguished by general ichthyological peculiarities, several primary combinations may be recognized, *viz.*:—1, an *Arctogean*, embracing Europe, Northern Asia, and Northern America; 2, an *Asiatic*, embracing the tropical portions of the continent; 3, an *African*, limited to the region south and east of the Desert; 4, an *American* (embracing the America *par excellence* dedicated to Amerigo Vespucci), including the tropical and transtropical portions; and, 5, an *Australasian*. Further, of these (a) the

first two have intimate relations to each other, and (*b*) the last three others among themselves; and some weighty arguments may be adduced to support a division of the faunas of the globe into two primary regions coinciding with the two combinations alluded to—(*a*) a CÆNOGÆA and (*b*) an EOGÆA, which might represent areas of derivation or gain from more or less distant geological epochs.

In connexion with the geographical distribution of fishes there are a couple of empirical facts which are also specially noteworthy. In the order of Teleocephali the Acanthopterygian types are vastly preponderant in the tropical and subtropical waters, while the jugular Malacopterygian types (*e. g.* Lycodidæ, Gadidæ, &c.) form a large proportion thereof in the polar regions. Further, and it is in the same direction, in Acanthopterygian types the vertebræ are actually or approximately 24, divided between 10 abdominal and 14 caudal, in the great majority of the tropical saltwater species; while in the cold-water forms (arctic and antarctic) the number is considerably increased. There are many exceptions to this generalization so far as the tropical forms are concerned; but the tendency in the direction in question is so decided, that while in the warm-water forms of the typical *Scorpeninæ* (*Sebastosomus*, *Scorpena*, &c.) the vertebræ are 24 (A. 10 + C. 14), in the representatives which are peculiar to the high north (*Sebastes norvegicus* and *S. viviparus*) the vertebræ are increased in number to 31 (A. 12 + C. 19). There is, however, no apparent physiological or morphological correlation between these and other facts, and we have in them perhaps nothing more than interesting cases of irrelative coincidence.

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XXXIII.—On an undescribed Organ in *Limulus*, supposed to be Renal in its Nature. By A. S. PACKARD, Jun.\*

In dissecting the king crab one's attention is directed to a large and apparently important gland, conspicuous from its bright red colour contrasting with the dark masses of the liver and the yellowish ovary or greenish testes, and presenting the same appearance in either sex. The glands are bilaterally symmetrical, one situated on each side of the stomach and beginning of the intestine, and each entirely

\* From an advance sheet of the 'American Naturalist,' communicated by the Author, having been read at the Philadelphia Meeting of the National Academy of Sciences, held in November 1874.